

## WHAT IS CLAIMED IS:

1. A logic element comprising:

5 a first saturable absorber for receiving a combined power of a first input optical signal and a reference signal, its passing power being higher than its absorbed power if the combined power is higher than a first transparent input power and its absorbed power being higher than its passing power if the combined power is lower than the first transparent input power;

10 a second saturable absorber for receiving a combined power of a second input optical signal having a wavelength different from that of the first input optical signal and the reference signal, its passing power being higher than its absorbed power if the combined power is higher than a second transparent input power and its absorbed power being higher than its passing power if the combined power is lower than the second transparent input power; and

15 a combiner for combining an output of the first saturable absorber and an output of the second saturable absorber,

wherein the reference signal has an optical power lower than the first and second transparent input powers, and the combined power of the first input optical signal and the reference signal and the combined power of the second input optical signal and the reference signal are higher than the first and second transparent input powers, respectively.

2. A logic element according to claim 1, wherein the reference signal

inputted to the first saturable absorber and the second saturable absorber is generated by dividing a continuous-wave signal into two half signals having the same powers, and the two half signals are inputted to the first and second saturable absorbers, respectively.

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3. A logic element according to claim 1, wherein the first transparent input power and the second transparent input power are equal to each other.

4. A logic element according to claim 1, wherein the reference signal  
10 inputted to the first saturable absorber and the second saturable absorber is generated by dividing a continuous-wave signal into two half signals having the same powers, and the two half signals are inputted to the first and second saturable absorbers, respectively.

15 5. A logic element according to claim 1, further comprising a phase shifter arranged between the first saturable absorber and the combiner or between the second saturable absorber and the combiner.

6. A logic element according to claim 5, wherein an XOR logic element  
20 is implemented when the phase shifter generates a phase difference by  $\pi$ , and an OR logic element is implemented when the phase shifter generates a phase difference by zero.

7. A logic element according to claim 1, further comprising an optical

amplifier provided at an output end of the combiner, the optical amplifier saturating its input optical signal when the input optical signal has an optical power higher than a saturation input optical power,

wherein a combined power  $P_{tr,out}$  of the first and second transparent  
5 output optical powers of the respective first and second saturable absorbers is higher than the saturation input optical power.